3

The Effect of Aldicarb on Sugarbeet Insects and Yield

U.S. Department of Agriculture
Agricultural Research Service
Agricultural Research Results•ARR-W-23/July 1982

A copy of this publication is available upon request from the Snake River Conservation Research Center, Route 1, Box 186, Kimberly, ID 83341.

This paper contains the results of research only. Mention of pesticides does not constitute a recommendation for use, nor does it imply that the pesticides are registered under the Federal Insecticide, Fungicide, and Rodenticide Act as amended. The use of trade names in this publication does not constitute a guarantee, warranty, or endorsement of the products by the U.S. Department of Agriculture.

International Standard Serial Number (ISSN) 0193-3817

Agricultural Research Service, Agricultural Research Results, Western Series, No. 23, July 1982

Published by Agricultural Research Service (Western Region), U.S. Department of Agriculture, Oakland, Calif. 94612

ABSTRACT

Approximately 450 species of insects were collected in sugarbeet fields in south-central Idaho over the 4-year period 1974 to 1977. Fifty-four species or species groups were taken from 50 percent or more of the fields sampled; 18 were classed as destructive or potentially destructive, 14 as beneficial, and 22 of unknown function. Of the 54, 18 were collected more commonly by sweep net, 34 were collected more commonly by pitfall traps, and 2 were collected equally by the two methods. Fourteen of the 54 were taken exclusively by pitfall traps. The apparent effect of aldicarb on insect populations varied widely with an overall reduction of about 20 percent. The effect of aldicarb treatment on the sugarbeet root maggot, curly top disease, lygus, and leaf miners in relation to plant stand and yield is presented.

KEYWORDS: *Beta vulgaris*, insects, sugarbeet root maggot, *Tetanops myopaeformis*, curly top, lygus, leafminers, survey methods, aldicarb, sugarbeet.

CONTENTS

THE EFFECT OF ALDICARB ON SUGARBEET INSECTS AND YIELD

C. C. Blickenstaff[1]

INTRODUCTION

In the United States, no systematic survey of the insects present in sugarbeet fields has been previously reported, and there are no reports on the effects of insecticide applications on beneficial insects. Data regarding economic threshold levels for the more commonly encountered destructive insects are also sparse. The frequency of occurrence and relative abundance of both destructive and beneficial insects are of importance to the development of an integrated pest management program. Ultimately, the value of any control program must rest heavily on economic return. In southern Idaho, the insect for which insecticides are currently most frequently applied is the sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), and research indicates one of the most used and effective insecticides for its control is aldicarb.

Three publications dealing with insect pests of sugarbeets in the United States may be cited as the most comprehensive. Chittenden (*1903*)[2] reported that approximately 150 insect species use sugarbeets as food, and 40 to 50 could be classed as noticeably destructive. He discussed 60 pest species and a few beneficial species individually. Maxson (*1948*) devoted 235 pages to 59 destructive and 17 beneficial insects or insect groups for the United States and Canada. Lange (*1971*) cited many destructive and beneficial species and gave 165 references to them.

The objectives of this study were (1) to survey and identify the more common insects present in sugarbeet fields in south-central Idaho, (2) to measure the effect of aldicarb on the more common insects, and (3) to measure the effect of aldicarb applied for control of SBRM on yield.

---

[1]Entomologist, Snake River Conservation Research Center, Route 1, Box 186, Kimberly, Idaho 83341.

[2]The year in italic, when it follows the author's name, refers to Literature Cited, p. 23.

METHODS

During 1974, 1975, and 1976, insects were sampled by sweep net in nine survey fields each year. In each field, sampling was done on an equal number of plots untreated and treated with an insecticide at planting in April or postemergence in early to mid-May for control of the SBRM. Pitfall traps were also used in one field in 1975, in all nine fields in 1976, and in four untreated fields in 1977. The sampling is summarized in table 1. Aldicarb (except in 1974 when other insecticides were used in three fields) was chosen as the treatment comparison because in other tests it had given the best yield increases when applied for control of the SBRM (Blickenstaff et al. *1981*).

Additional survey fields were established in eastern Idaho in cooperation with personnel of the Utah-Idaho Sugar Co. and in western Idaho with personnel of The Amalgamated Sugar Co. in 1974, 1975, and 1976. Only SBRM and yield data were obtained from these fields. All 41 fields were used to relate SBRM populations to yield increase due to aldicarb treatment.

Fields for sampling were chosen by sugar industry personnel to provide distribution throughout the beet-growing area of southern Idaho. Sweep net and pitfall sampling were restricted to south-central Idaho. Insecticide applications were made with a tractor-mounted applicator either at planting with shoe and sweeps that placed the granular material in a 5-inch band about 1-inch deep, centered on the row and immediately ahead of the planter, or postemergence using a Ro-Bander followed by a drag chain for light incorporation. In all applications, active ingredient per acre (AI/A) of aldicarb were applied.

Three sticky stake traps were set in borders of each field and examined two to three times per week to determine SBRM fly populations (Blickenstaff and Peckenpaugh *1976*).

Sweep net samples were taken periodically with a standard 15-inch insect net. Insects collected were killed in the field with ethyl acetate and stored for sorting and counting during the following winter.

Pitfall traps were 16-fluid-oz tapered plastic cups set in the beet row with the rim at ground level with a 3-1/2-oz plastic cup inside. A 4-oz plastic funnel fit snugly into the larger cup and opened to the smaller cup. The small cup was half filled with a preservative composed of 600 parts water; 400, ethylene glycol; 5, formalin; and 1 to 2, detergent. One trap was placed in the center of each plot and serviced weekly. Insects collected were stored in 80-percent alcohol for later sorting and counting.

Representative specimens of insects collected were pinned and numbered, and duplicates were sent to the U.S. National Museum for positive identification. The collection is stored at the U.S. Department of Agriculture, Snake River Conservation Research Center, Kimberly, Idaho.

During July, 12, 10, 20, and 20 beets were dug per plot in 1974, 1975, 1976, and 1977, respectively. In 1974, soil around the beets was sifted to recover

Table 1.--*Sugarbeet fields sampled for insects in south-central Idaho and method of sampling*

Year	Sweep net samples: No. fields	Plot size	No. plots[1] per field	No. sweeps per plot	No. collections per field	Pitfall trap samples: No. fields	No. traps per plot	No. plots[1] per field	No. collections per field
1974	[2]9	1 acre	2	20	4 [3](6/25-10/1)				
1975	9	44 x 100 ft	8	10	3-5 (6/5-8/18)	1	1	8	6 (6/24-7/28)
1976	9	44 x 100 ft	8	25	2 (7/13-8/11)	9	1	8	4 (6/14-7/7)
1977		100 x 100 ft				4	4	1	11 (4/22-8/8)

[1]Except for 1977 (untreated), half the plots in each field were taken with aldicarb and half were untreated.
[2]Only 6 of these plots were treated with aldicarb.
[3]First and last sampling dates are in parentheses.
Note: Blank spaces indicate no samples taken.

maggots; in later years, beet roots were rated for SBRM damage on a scale of 0 = no damage to 5 = severely damaged, dying, or dead. Occasionally, other insect damage was recorded.

In October and November, just before grower harvest, yield data were obtained by hand digging 10, 20, 50, and 100 feet of row per plot in 1974, 1975, 1976, and 1977, respectively.

RESULTS

The More Common Insects Found by Survey

Approximately 450 species of insects were collected during the 4 years of sampling. These are grouped by order in table 2. Approximately 6,000 specimens were counted from sweep net samples and 22,000 from pitfall traps in untreated or check plots. By far, the most numerous by sweep net sampling were Diptera and Homoptera. In pitfall traps, Collembola and Diptera were most numerous. The large number of Collembola is due mainly to heavy infestation in a single field in 1976.

Only those 54 species or groups that were common (collected in half or more of the fields sampled) by either sampling method are considered further. Of these, 18 species are destructive or potentially destructive, 14 are known to be beneficial, and 22 have functions unknown to us. These are listed in tables 3, 4, and 5. They comprise 70.6 percent of the total individuals collected by sweeping and 90.2 percent (exclusive of Collembola) collected in pitfall traps.

The two sampling methods complemented one another nicely. Of the 54 species or groups, 18 were collected in a higher percentage of fields by sweeping and 34 in a higher percentage (14 exclusively) by pitfall traps. Two species were collected equally by the two methods.

The most commonly collected (present in 93 to 100 percent of fields surveyed) destructive species or groups by sweeping were *Lygus* spp., three leafhoppers (including the beet leafhopper), a leaf miner (*Psilopa leucostigma* (Mg.)), and the seed corn maggot (*Hylemya platura* (Mg.)). Pitfall trapping added two additional leafhoppers (*Aceratagallia fuscoscripta* Oman and *Exitianus exitiosus* (Uhler)), the SBRM (*Tetanops myopaeformis* (Röder)), and Collembola. Most of those listed in table 3 were discussed by Maxson (*1948*) and, with one exception, by Lange (*1971*) either by species or group as pests of sugarbeets. The exception is the *Psallus* and *Atomoscelis* group (Miridae), which are close relatives of *Pseudatomoscelis seriatus* (Reuter), the cotton fleahopper, and are considered here as potential pests of sugarbeets.

Many of the pest species discussed by Maxson (*1948*) and Lange (*1971*) were not found commonly in our sampling. Perhaps the most important of these was the green peach aphid, *Myzus persicae* (Sulzer), an important vector if virus yellows diseases. Other widely recognized pests seen only occasionally during this study were the bean aphid (*Aphis fabae* Scopoli) and the sugarbeet root aphid

Text continues on page 12.

Table 2.--*Effect of aldicarb applied for control of the sugarbeet root maggot in south-central Idaho on insect orders and spiders*[1]

Order	Sweep net samples								Pitfall trap samples					
	1974 (6)[2]		1975 (9)		1976 (9)		Totals (24)		1975 (1)		1976 (9)		Totals (10)	
	No. in check	Percent reduc-tion in treated	No. in check	Percent reduc-tion in treated	No. in check	Percent reduc-tion in treated	No. in check	Percent reduc-tion in treated	No. in check	Percent reduc-tion in treated	No. in check	Percent reduc-tion in treated	No. in check	Percent reduc-tion in treated
Collembola	0		0		0		0		67	19.4	18,887	44.2	18,954	44.1
Diptera	825	20.5	1,144	21.8	785	24.4	2,727	21.4	206	53.4	998	1.8	1,204	10.6
Homoptera	614	31.8	597	7.9	798	21.2	2,009	20.4	141	22	425	16.9	566	18.2
Hymenoptera	72	56.9	29		103	47.6	204	37.7	113	45.1	528	3	641	10.4
Hemiptera	149	18.8	125	15.2	144	28.5	418	21	40		336	53.6	376	51.9
Coleoptera	66	4.5	36		51	17.6	153	11.1	147	19.7	421	20.7	568	20.4
Thysanoptera	61	+103.3	158	44.3	158	32.4	377	18	1		11		12	
Spiders	22		8		57	5.3	87	+16.1	29		89	39.3	118	30.5
Miscellaneous[3]	29		3		8		40				17		17	
Totals							6,015	20.4					22,456	40.1
Totals excluding Collembola													3,490	18.6

[1]Percent change in population is given only where groups were represented by 50 or more individuals. All percent values are negative unless otherwise indicated.

[2]Number of fields sampled.

[3]Includes Neuroptera, Orthoptera, and Lepidoptera.

Table 3.--*Effect of aldicarb on destructive or potentially destructive insects common*[1] *in 27 sugarbeet fields sampled by sweeping and 14 fields sampled by pitfall traps*

Order Family Species	Sweep net samples: Percent frequency	Sweep net samples: Untreated (No. individuals)	Sweep net samples: Treated (percent reduction)[2]	Pitfall trap samples: Percent frequency	Pitfall trap samples: Untreated (No. individuals)	Pitfall trap samples: Treated (percent reduction)[2]	Average percent reduction (weighted by No. individuals)[2]
Hemiptera							
Miridae							
Lygus elisus Van Duzee and *L. hesperus* Knight.	96	108	+13	64	22	(59)	+0.8
Psallus sp. and *Atomoscelis modestus* (Van Duzee).[3]	56	27	(37)	64	31	(55)	(46.6)
Homoptera							
Cicadellidae							
Dikraneura carneloa (Stål).	100	464	+14	43	7	(14)	+13.6
Macrosteles fascifrons (Stål).	100	407	4	29	7	(86)	5.4
Circulifer tenellus (Baker).	96	343	64	100	100	28	55.9
Psammotettix sp.	63	103	67	71	6	(+83)	58.7
Aceratagallia fuscoscripta Oman.	78	99	21	100	251	30	27.4
Exitianus exitiosus (Uhler).	81	39	(18)	93	146	8	10.1

Euscelidius variegatus (Kbm.).	33	6	(17)	50	32	(0)	(2.7)
Aphidae[4]	74	47	(0)	7	5	(+40)	+3.8
Coleoptera							
Elateridae	0	0	--	50	2	(50)	(50)
Tenebrionidae							
Blapstinus oregonensis Casey.	0	0	--	86	18	(+11)	(+11)
Diptera							
Ephydridae							
Psilopa leucostigma (Mg.).	100	1,016	22	50	2	(100)	22.2
Anthomyiidae							
Hylemya platura (Mg.).	100	204	33	100	736	7	12.6
Pegomya betae (Curtis).	26	68	53	79	150	27	35.1
Otitidae							
Tetanops myopaeformis (Röder).	33	10	(60)	93	20	(+10)	(13.3)
Collembola	4	0	(+)	100	18,954	44	44

[1] Present in 50 percent or more of fields sampled by either method.

[2] All values are negative unless otherwise indicated. Values based on less than 50 specimens are in parentheses.

[3] These species are similar and were combined in our records.

[4] Mostly *Macrosiphum avenae* (F.).

Table 4.--*Effect of aldicarb on beneficial insects common*[1] *in 27 sugarbeet fields samples by sweeping and 14 fields sampled by pitfall traps*

Order Family Species	Sweep net samples: Percent frequency	Sweep net samples: Untreated (No. individuals)	Sweep net samples: Treated (percent reduction)[2]	Pitfall trap samples: Percent frequency	Pitfall trap samples: Untreated (No. individuals)	Pitfall trap samples: Treated (percent reduction)[2]	Average percent reduction (weighted by No. individuals)[2]
Hemiptera							
Anthocoridae							
Orius tristicolor (White).	81	99	13	36	0	(+)	13
Nabidae							
Nabis americoferus Carayon.	81	39	(15)	14	1	(0)	(12.7)
Lygaeidae							
Geocoris pallens Stål.	74	58	45	100	308	56	54.2
Coleoptera							
Coccinellidae							
Hippodamia convergens (Guérin-Menéville).	48	13	(62)	43	5	(40)	(55.9)
Carabidae							
Bembidion sp. #3	0	0	--	100	136	28	28
Bembidion sp. #1	0	0	--	93	55	5	5
Amara (2 spp., #4)	4	5	(100)	86	18	(22)	(39)
Metabletus sp., #10.	11	3	(33)	71	21	(+28)	(+20.4)
Diptera							
Chloropidae							
Thaumatomyia glabra (Mg.).	89	412	58	64	7	(+29)	56.8

Hymenoptera							
Braconidae							
Biosteres spinaciae (Thom.).	85	93	77	43	1	(0)	76.2
Eulophidae and *Pteromalidae*.	59	20	(+5)	14	0	(+)	(+5)
Aphidiidae							
Aphidius sp., #18.	56	15	(13)	7	0	(+)	(13)
Mymaridae	67	11	(+109)	7	0	(+)	(+109)
Araneida (spiders)	93	87	+16	93	118	30	10.5

[1]Present in 50 percent or more of fields sampled by either method.

[2]All values are negative unless otherwise indicated. Values based on less than 50 specimens are in parentheses.

Table 5.--*Effect of aldicarb on insects of unknown function common*[1] *in 27 sugarbeet fields sampled by sweeping and 14 fields sampled by pitfall traps*

Order Family Species	Sweep net samples: Percent frequency	Sweep net samples: Untreated (No. individuals)	Sweep net samples: Treated (percent reduction)[2]	Pitfall trap samples: Percent frequency	Pitfall trap samples: Untreated (No. individuals)	Pitfall trap samples: Treated (percent reduction)[2]	Average percent reduction (weighted by No. individuals)[2]
Coleoptera							
Anthicidae							
Anthicus sp. #14	37	8	(+100)	86	39	(28)	(6.2)
Anthicus sp. #27	4	0	(+)	50	16	(50)	(50)
Lathridiidae							
Corticaria probably *elongata*.	63	48	(+10)	29	3	(67)	+5.5
Scarabiidae							
Aphodius granarius (L.).	4	1	(+300)	100	41	(41)	(32.9)
Genus and sp. (?) #15.	0	0	--	79	8	(+75)	(+75)
Staphylinidae							
Genus and sp. (?) #23.	0	0	--	86	18	(56)	(56)
Genus and sp. (?) #33.	4	0	(+)	71	20	(40)	(40)
Genus and sp. (?) #41.	0	0	--	93	26	(+27)	(+27)
Genus and sp. (?) #8.	0	0	--	57	4	(+100)	(+100)
Diptera							
Heleomyzidae							
Pseudoleria sp. #80, #112.	0	0	--	79	10	(+100)	(+100)

Lauxaniidae							
Camptoprosopella borealis Shewell.	59	224	17	21	4	(50)	17.6
Chironomidae genus and sp. (?) #22, #38.	70	55	+65	36	1	(0)	+63.8
Sciaridae							
Bradysia sp. #14	70	69	23	100	132	19	20.4
Drosophilidae							
Scaptomyza pallidae (Zett.).	56	30	(+210)	7	0	(+)	(+210)
Phoridae mostly							
Megaselia sp. #18	30	4	(+75)	57	6	(+17)	(+40.2)
Sepsidae							
Saltella sphondylii (Schrank).	11	3	(0)	64	59	37	35.2
Hymenoptera							
Halictidae							
Halictus tripartitus Ckll.	7	4	(50)	86	108	+29	+26.2
Dialictus albohirtus (Cfwd.).	0	0	--	100	208	11	11
Dialictus hunteri Vier.(?).	0	0	--	50	13	(+54)	(+54)
Agapostemon sp. #33.	0	0	--	93	127	38	38
Formicidae							
Formica neoclara (Emery).	18	2	(+550)	71	84	11	+2
Pogonomyrmex owyhee Cole.	0	0	--	64	16	(0)	(0)

[1]Present in 50 percent or more of fields sampled by either method.
[2]All values are negative unless otherwise indicated. Values based on less than 50 specimens are in parentheses.

(*Pemphigus populivenae* Fitch). Of the numerous lepidopterous species recorded elsewhere as pests, no cutworms were collected and only an occasional defoliator was observed in our survey.

Of the common beneficial insects or groups (table 4), Maxson (*1948*) discussed only a few, but Lange (*1971*) discussed all but spiders. All Hemiptera and Coleoptera listed in table 4 are general predators on other insects and mites. *Thaumatomyia glabra* (Mg.) is a common and important parasite of the sugarbeet root aphid, which may indicate the latter to be more common than our sampling indicated. The *Aphidius* sp. is a parasite of aphids. The Mymaridae are parasites of insect eggs. Hosts of the other Hymenoptera are unknown to us. *Geocoris pallens* Stål, the carabids, and spiders were collected from more fields than other species. Of the commonly occurring insects of unknown function (table 5), only six were collected in numbers of 50 or more.

Additional General Observations of Destructive Insects or Damage

In addition to insects observed in these survey fields, our attention has occasionally been directed by growers, sugarbeet company personnel, and, in the course of other phases of our research, to severe infestations or damage.

The SBRM caused severe loss of stand in the Indian Cove area near Hammett in 1975. Severe damage was observed in western Idaho south of Nampa in 1976, and several fields (approximately 400 acres) were replanted. Approximately 30- to 40-percent stand losses were observed in two untreated fields 10 miles north of Paul in 1979.

In 1977, a localized outbreak of curly top occurred in the Buhl, Filer, Twin Falls, Murtaugh area south of the Snake River in the Twin Falls Factory District. This was the only district of the four in Idaho and one in eastern Oregon of The Amalgamated Sugar Co. that showed a decline in yield in 1977 as compared with the previous 7-year average. Within the Twin Falls Factory District in the Jerome area north of the Snake River, yield was 101 percent of the previous 5-year average. South of the Snake River, the overall decrease in yield was 22 percent. Further subdivision of the southside area showed yield decreases of 32 percent in the Buhl and Filer area and 36 percent in the Murtaugh area. In a field south of Buhl, yield was reduced 40 percent in a highly resistant variety and 70 percent in a variety only partially resistant. In that year, 12 percent of the sugarbeet acreage in the Twin Falls Factory District was planted to the less resistant variety (personal communication, Del Traveller, The Amalgamated Sugar Co., Twin Falls). Also in 1977, in a test at Kimberly, a highly susceptible variety had 93 percent infected plants from a natural infestation of the beet leafhooper.

In 1978, we conducted a curly top survey of 21 fields in Lincoln, Minidoka, Cassia, Jerome, and Twin Falls Counties and found negligible curly top symptoms (<1 percent to 3 percent) in only four fields.

Although cutworms have been mentioned by sugarbeet company personnel as occasionally damaging, we have observed only one field suffering 5 to 10 percent stand loss in the early season of 1974.

The bean aphid severly damaged a beetfield near Twin Falls in 1974 and infested up to 55 percent of the plants in an insecticide test at Kimberly. It was apparently a significant factor in reducing yield in an insecticide test at Kimberly in 1978.

The sugarbeet wireworm, *Limonius californicus* (Mannerheim), caused approximately 40-percent stand reduction in spots in a field near Kimberly in July 1978. Up to 23 wireworms per plant were recovered.

Lepidopterous defoliators, particularly the zebra caterpillar, *Ceramica picta* (Harris), have been commonly observed but in very low numbers and never causing serious damage.

The sugarbeet root aphid, although common, was not observed as causing serious damage.

Effect of Aldicarb on the More Common Insects Surveyed

The effect of aldicarb as applied for SBRM control on arthropod populations by order is shown in table 2. The overall populations were reduced 20.4 percent based on 6,015 specimens collected by sweep net sampling and 18.6 percent based on 3,490 specimens (exclusive of Collembola) collected in pitfall traps. The 44.1-percent reduction of Collembola is based largely on a single field where the population was very high in 1976. The only order reduced about the same (20.4 percent and 18.2 percent), as indicated by both sampling methods, was Homoptera. Differences in percent population reduction measured by the two methods were large for Diptera, Hemiptera, Coleoptera, and Hymenoptera. This is undoubtedly due to the differing species complexes collected by the two methods. There was also little consistency among years for sweep net sampling.

Indicated changes in populations due to aldicarb treatment are given for destructive, beneficial, and insects whose function is unknown in tables 3, 4, and 5, respectively. Percentage changes varied widely between the two sampling methods. If only those seven species or groups with 50 or more individuals collected by both methods are compared, the differences are still great:

	Sweep net	Pitfall
	Percent reduction[1]	
Table 3:		
Circulifer tenellus	64	28
Aceratagallia fuscoscripta	21	30
Hylemya platura	33	7
Pegomya betae	53	27

	Sweep net	Pitfall
	Percent reduction[1]	
Table 4:		
Geocoris pallens	45	56
Spiders	+16	30
Table 5:		
Bradysia sp.	23	19
Average	31.8	28.1

[1]All values are negative unless otherwise indicated.

There is no correlation between the two sampling methods, but their mean values indicate an overall population reduction of about 30 percent.

The large differences in effect of aldicarb treatment shown for related species also indicate that little reliance can be placed on individual values for either sampling method or for their average value. For example, average percent change for the seven leafhoppers (Cicadellidae, table 3) varied from an increase of 13.6 to a decrease of 58.7. Some of these species may be only migrants, however, and, thus, perhaps were not affected by the treatment. Percent reduction of the beet leafhooper, *Circulifer tenellus* (Baker), by sweep net sampling agrees fairly well with average reduction in curly top disease as observed in other tests (57 percent, No. of fields (n) = 8). Reductions shown for adults of the leaf miners *Psilopa* and *Pegomya* of 22.2 percent and 35.1 percent (table 3) compared with almost complete control observed in other insecticide tests (Blickenstaff et al. *1981*) and with 75.3 percent average reduction by field count of mines in these tests (n = 21).

Aldicarb causes some mortality of insects either in the soil or feeding on plants above ground for 60 to 90 days after application. Most applications were made in April and early May; therefore, the data were examined to see if early appearing species were affected more than late-appearing species. There was no clear-cut trend for leafhoppers (table 6). The three late-appearing species were reduced due to treatment to about the same extent as the two early appearing species except for sweep net collections made late in the season. Pitfall trapping indicated only about one-half the reduction overall as did sweep net sampling (37 versus 19 percent) for the same time period.

For those species or groups of beneficial insects (table 4) represented by 50 or more specimens, the average population reduction due to aldicarb treatment was 35 percent (n = 5) by sweeping and 30 percent (n = 4) by pitfall trapping. Population reductions averaged over both sampling methods and for species with combined numbers of 50 or more ranged from 5 percent for *Bembidion* sp. No. 1 to 76 percent for *Biosteres spinaciae* (Thom.).

Of the commonly occuring insects of unknown function (table 5) represented by 50 or more specimens, the change in population due to aldicarb treatment

Table 6.--*Reduction*[1] *in leafhoppers due to aldicarb treatment in relation to time of first seasonal appearance*

	June 16-July 30				Aug. 1-Sept. 30		Periods[2] when present in collections											
	Sweep net samples		Pitfall trap samples		Sweep net samples		Apr.		May		June		July		Aug.		Sept.	
	No. specimens in check	Percent reduction treated	No. specimens in check	Percent reduction treated	No. specimens in check	Percent reduction treated	1	2	1	2	1	2	1	2	1	2	1	2
Circulifer tenellus	216	62	100	28	128	65		-	-	-	-	-	-	-	-	-	-	-
Aceratagallia fuscoscripta	64	47	251	30	21	(0)		-	-	-	-	-	-	-	-	-	-	-
Exitianus exitiosus	17	(24)	146	12	15	(67)					-	-	-	-	-	-	-	-
Dikraneura carneola	138	4	0	--	325	2					-	-	-	-	-	-	-	-
Macrosteles fascifrons	63	56	5	(100)	342	1						-	-	-	-	-	-	-
Euscelidius variegatus	1	(100)	32	(25)	1	(100)						-	-	-	-			
Psammotettix sp.	6	(0)	6	(17)	83	93						-	-	-	-	-	-	-
Combined species:																		
First two	270	61	351	29	149	56												
Second two	155	6	146	12	340	5												
Last three	70	52	43	33	426	19												
Totals	505	37	540	19	917	11												

[1]Percent reduction based on fewer than 50 individuals is in parentheses.
[2]Months are divided into halves; 1 = first half, 2 = second half.

varied from an increase of 64 percent for Chironomidae to a decrease of 38 percent for the ground nesting bee, *Agapostemon* sp. Again, the large differences in apparent effect between sampling methods and among species within groups (Staphylinidae, Halictidae) of similar habits make individual and average values highly suspect.

Effect of Control of Major Insect Pests on Beet Stand and Yield

One of the major objectives of the study was to determine the effect of controlling insects, primarily the SBRM, on sugarbeet yield. In the 27 fields where periodic collections and visits were made, additional counts were made on lygus stings, leaf miners, and curly top in plots treated with aldicarb and not treated. An additional 14 fields furnished some further data on SBRM levels and yield. Data for individual fields are given in table 7 and a summary in table 8. Since the data indicated widely varying infestations and degree of control due to treatment, the differences between treated and check plots converted to $\sqrt{x + 0.5}$ or $\sqrt{x + 0.1}$ were used to compare the four variables with beet stand (percent increase or decrease from untreated) and yield (tons per acre increase or decrease from untreated).

As shown by correlations in table 9, all measurements of SBRM flies, maggots, and damage ratings were postively associated with differences in percent stand and yield. SBRM damage ratings in untreated checks and the difference in damage ratings between treated and untreated were significantly correlated with changes in stand ($r = 0.446^*$, $n = 23$; and $r = 0.436^*$, $n = 23$ respectivley), but not with changes in yield. The lower correlation values for yield were probably due to the ability of beets to compensate in yield for differences in stand even though in this study stand and yield were significantly correlated ($r = 0.515^{**}$, $n = 30$).

As found in previous studies, the number of flies trapped per sticky stake was significantly correlated with damage ratings in untreated plots ($r = 0.695^{**}$, $n = 23$) and postively, but not significantly, correlated with number of maggots per beet ($r = 0.485$, $n = 9$). These values were both reported as 0.91** based on survey data obtained in 1974 and 1975 (Blickenstaff and Peckenpaugh *1976*).

The relationship between SBRM fly populations and yield change is shown in figure 1. The data indicate that even in the absence of flies, yield would be expected to increase by appoximatley 0.7 T/A on the average. This is attributed to the fact that aldicarb effectively controls several other above- and below-ground insects and nematodes. When fly populations were greater than 150 per sticky stake, yield was increased in seven of eight fields with an averge increase of 2.52 T/A.

If the one field that did not show a yield increase (soil preparation and irrigation were inadequate) were omitted, the average yield increase for the remaining seven fields would be 3.15 T/A. The two highest yield increases (7.12 and 10.15 T/A) are shown for relatively low fly populations (74 and 60 flies per stake). In addition to inherent error in measurements other biological factors

Text continues on page 21.

Table 7.--*Data from survey fields on sugarbeet root maggot (SBRM) infestations and damage, lygus, leaf miner, curly top, plant stand, and yield, and differences between plots treated with aldicarb (T) and untreated checks (Ck), 1974-77*

	SBRM							Curly top			
Field year-No.	No. flies per stake	Damage rating Ck	Damage rating T-Ck $\sqrt{x + 0.5}$	No. maggots per beet Ck	No. maggots per beet T-Ck $\sqrt{x + 0.5}$	Lygus T-Ck $\sqrt{x + 0.5}$	Leaf miner T-Ck $\sqrt{x + 0.5}$	Percent T-Ck	Percent T-Ck $\sqrt{x + 0.1}$	Plant stand (percent increase or decrease over check	Yield (tons per acre) T-Ck
South-central Idaho:											
75-7	74	2.58	1.41			0.71	2.90	0	0.32	113	7.12
74-2	41			0.10	0.71	.86	.77	28.4	5.34	-2	4.25
77-1	16	2.70	1.66					7.5	2.76		5.00
75-2	3	.15	.72			.89	1.64	6.4	2.55	6	4.16
76-1	12	.20	.77			.71	1.95	0	.32	-4	4.70
75-9	280	3.98	1.16			.71	1.33	0	.32	40	3.33
76-8	18	1.20	1.00			2.06	.82	0	.32	12	4.17
74-8	166			3.20	.71	.95	1.90	0	.32	-5	3.36
76-3	23	1.90	.83			2.96	1.13	0	.32	3	2.34
76-4	40	1.50	1.22			.71	.92	0	.32	-3	2.82
76-6	32	1.50	1.38			.71	1.19	0	.32	10	1.91
75-6	93	2.15	1.08			.77	1.10	0	.32	7	1.07
76-7	57	2.10	1.58			.74	.89	0	.32	11	1.71
76-9	190	2.50	1.34			.74	.87	0	.32	-8	1.20
74-7	102			2.20	1.31	.93	.77	0	.32	34	1.49
75-1	0	.02	.71			.71	1.92	0	.32	-11	.95
77-2	91	.20	.77					0	.32	-7	.69
74-1	2			0	.71	1.51	.77	0	.32	2	.39
76-2	138	2.20	.90			2.04	.77	0	.32	4	.02
74-6	122			.50	1.00	.89	5.10	0	.32	-16	-.21
75-5	29	1.65	.71			1.05	2.07	0	.32	-10	-.24
76-5	3	.20	.77			.71	2.44	0	.32	-20	-1.51
75-4	9	1.52	.91			1.20	1.92	6.0	2.47	-23	-1.31
75-8	7	.88	.96			.71	4.01	0	.32	4	-1.40
77-4	298	3.40	1.44					0	.32	0	-1.88
74-3	42			0	.71	.84	.77	10.8	3.30	-8	-3.95
75-3	21	1.98	1.06			1.73	3.21	0	.32	7	-4.16
East and west Idaho:											
74-10	96			0	.71						1.98
74-11	91			2.00	.84						
74-12	60			2.50	1.67						10.15
74-13	338			4.00	2.12						3.14
74-15	91			0	.71						
74-16	352			2.50	1.48						2.33

Table 7.--*Data from survey fields on sugarbeet root maggot (SBRM) infestations and damage, lygus, leaf miner, curly top, plant stand, and yield, and differences between plots treated with aldicarb (T) and untreated checks (Ck), 1974-77*--Continued

Field year-No.	SBRM: No. flies per stake	SBRM: Damage rating Ck	SBRM: Damage rating $\frac{T-Ck}{\sqrt{x+0.5}}$	SBRM: No. maggots per beet Ck	SBRM: No. maggots per beet $\frac{T-Ck}{\sqrt{x+0.5}}$	Lygus $\frac{T-Ck}{\sqrt{x+0.5}}$	Leaf miner $\frac{T-Ck}{\sqrt{x+0.5}}$	Curly top: Percent T-Ck	Curly top: Percent $\frac{T-Ck}{\sqrt{x+0.1}}$	Plant stand (percent increase or decrease over check	Yield (tons per acre) T-Ck
74-18	198			0.10	0.71						3.76
75-10	81									0	1.64
75-11		0.58	0.97							18	7.54
75-13	96	.62	.90							5	2.08
75-14	1	.10	.71							-1	-1.67
75-15	64	1.80	1.35							-10	-.63
76-11	119										1.01
76-12	230										4.96

Note: Blank spaces indicate no data.

Table 8.--*Description of data from survey fields and percent control of major insects or their damage following treatment with aldicarb*

	No. fields	Mean	Range	Standard deviation	Coefficient of variation (percent)
Sugarbeet root maggot:					
No. flies per stake	40	93.15	0-352	95.57	103
No. maggots per beet in check	13	1.32	0-4	1.45	110
Damage rating in check	25	1.5	0.025-3.4	1.08	72
Percent control based on damage rating.	24	43.1	0-95	29.2	68
Percent control based on No. maggots.	9	49.8	0-100	46.1	92
Curly top:					
Percent infected[1] in check	27	3.1	0-33	7.2	231
Percent control	7	55.7	0-100	40.8	73
Lygus:					
No. stings per plant in check	24	1.5	0-11.6	2.5	165
Percent control	21	40.6	0-100	33.7	83
Leaf miner:					
No. mines per plant in check	24	5.1	<1-25.5	6.7	132
Percent control	21	75.3	24-100	23.5	31
Yield (T/A):					
Treated with aldicarb	39	25.37	16.39-36.23	5.49	22
Untreated check	39	23.52	15.32-37.9	5.96	25

[1]7 of 27 fields with symptoms; range 4 to 33 percent.

Table 9.--*Correlations (r) between major insects and insect damage*[1] *with changes*[2] *in sugarbeet plant stand and yield (from data in table 7)*

	Plant stand (percent of check)		Yield (tons per acre) T-C	
	No. fields	r	No. fields	r
Sugarbeet root maggot:				
Total No. flies per stake	27	0.227	35	0.317
Damage rating in untreated check	23	.446*	25	.013
Damage rating T-C $\sqrt{x + 0.5}$	23	.436*	25	.189
No. maggots per beet (1974)	4	.361	8	.163
No. maggots per beet T-C $\sqrt{x + 0.5}$	6	.693	11	.409
Curly top percent T-C	4	.272	5	.250
Curly top percent T-C $\sqrt{x + 0.1}$ + SBRM damage T-C $\sqrt{x + 0.5}$.	27	.051	21	.261
Leaf miner T-C $\sqrt{x + 0.5}$	24	.009	24	-.230
Lygus T-C $\sqrt{x + 0.5}$	24	-.074	24	-.095
Plant stand, percent of check			30	.515**

[1]Additional correlations and regressions were: No. flies vs. damage rating, n = 23, r = 0.695**, a = 0.9991, b = 0.0088; No. flies vs. No. maggots, n = 9, r = 0.485, a = 0.9365, b = 0.0059.

[2]T-C = the difference between treated with aldicarb and untreated check plots.

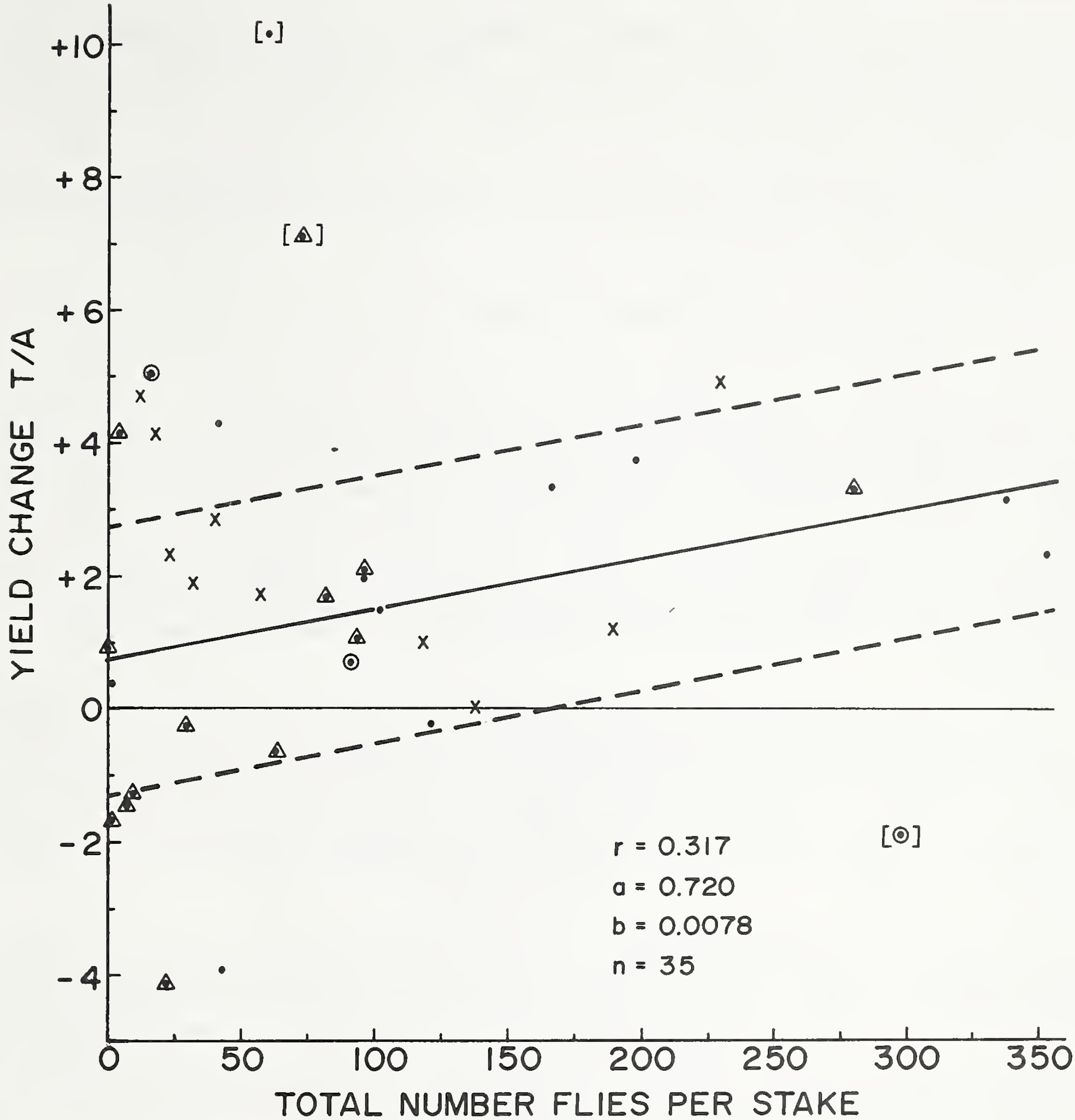

Figure 1.--The relationship between sugarbeet root maggot fly population and sugarbeet yield change in tons per acre following application of aldicarb at planting or soon after plant emergence. Year of observations: • 1974, ▲ 1975, X 1976, ⊙ 1977. Three data points in brackets are not included in regression. Dashed lines are ±2 tons per acre from regression line.

were probably operating. If these three most widely divergent sets of data points were omitted, the correlation and regression values would become r = 0.317 (very close to significance at the 5-percent level), a = 0.720, and b = 0.0078 (n = 35). If we omit the three most widely divergent data sets, 66 percent of the remaining 35 data sets would be included within ±2 T/A of the regression line

(fig. 1). With less than 150 total flies trapped per stake, the average yield increase was 0.82 T/A (range, -4.2 to 5.0). With less than 50 flies trapped per stake, increased yields were still indicated for 59 percent of the 17 fields with an average of 0.72 T/A (range, -4.2 to 5.0).

No significant effects of lygus, leaf miner, or curly top on either stand or yield were found in this study (table 9). Only 7 of the 27 survey fields had curly top, and only 1 of these had a moderate infection of 33 percent.

SUMMARY AND CONCLUSIONS

During a survey of sugarbeet fields conducted in south-central Idaho over four growing seasons (1974 to 1977), approximatley 450 species of insects were collected. Of these, 54 species or groups were collected in 50 percent or more of the 27 fields surveyed by sweeping or the 14 fields surveyed using pitfall traps. Of the 54, 18 are destructive or potentially destructive, 14 are beneficial, and the function of 22 is unknown to us. These 54 species comprised 70 and 90 percent of the total individuals collected by sweeping and pitfall traps, respectively. A few species listed as pests by other authors were not found commonly in this study, most notably the green peach aphid and lepidopterous defoliators.

The two sampling methods were complementary: 18 species or groups (of 54) were collected in a higher percentage of fields by sweep net, 34 in a high percentage by pitfall traps, and 2 equally by both methods. Fourteen species were taken exclusively by pitfall traps. Aldicarb treatment reduced the overall insect population about 20 percent as measured by both sampling methods, but the two sampling methods were seldom in close agreement when compared by individual species or groups.

The effect of aldicarb treatment on some of the more prevalent or obvious insects and their damage (SBRM, lygus, beet leaf miner, and curly top transmitted by the beet leafhopper) is presented and examined by correlation with changes in sugarbeet plant stand and yield. Leaf miner and lygus control had no apparent effect on stand or yield. SBRM flies, maggots and damage, and curly top were all positively associated with stand and yield; that is, as the magnitude of difference between plots treated with aldicarb and untreated checks increased, the differences in stand and yield also increased. The correlations with stand tended to be greater than those with yield, which is attributed to the ability of beets to compensate in yield for reductions in plant stand. The only significant correlations were between SBRM damage ratings and plant stand.

The correlation between total number of SBRM flies trapped per sticky stake and yield change due to aldicarb treatment was nearly significant at 5-percent level of probability ($r = 0.317$, $n = 35$). Since flies per sticky stake can be rather easily monitored and control applied on this basis as needed, the regression is given. Yields increased 1.2 to 4.9 T/A when fly populations were more than 150 per sticky stake for the season and aldicarb was applied at or soon after planting. Even in the absence of flies, yield would be expected to be increased 0.72 T/A on the average. This is attributed to the control of other insects and organisms.

LITERATURE CITED

(1) Blickenstaff, C. C., and R. E. Peckenpaugh.
1976. Sticky stake traps for monitoring fly populations of the sugarbeet root maggot and predicting maggot populations and damage ratings. Journal of the American Society of Sugar Beet Technologists 19(2):112-117.

(2) Blickenstaff, C. C., R. E. Peckenpaugh, D. Traveller, and J. D. Stallings.
1981. Insecticide tests for control of the sugarbeet root maggot, 1968-78. U.S. Department of Agriculture, Science and Education Administration, Agricultural Research, Western Region, ARR-W-18, 75 p.

(3) Chittenden, F. H.
1903. A brief account of the principal insect enemies of the sugar beet. U.S. Department of Agriculture, Division of Entomology, Bulletin No. 43, 71 p.

(4) Lange, W. H.
1971. Insects and mites and their control. *In* Advances in sugarbeet production: principles and practices, p. 287-333. The Iowa State University Press, Ames, Iowa.

(5) Maxson, A. C.
1948. Insects and diseases of the sugar beet. Beet Sugar Development Foundation, Fort Collins, Colo. 425 p.

ACKNOWLEDGMENTS

Personnel of The Amalgamated Sugar Co. located test fields in south-central and western Idaho and assisted with some of the harvests. Personnel of the Utah-Idaho Sugar Co. located test fields in eastern Idaho.

Representative specimens were identified by specialists of the U.S. National Museum, Washington, D.C. Bees were identified by G. Bohart, USDA, ARS, Logan, Utah.

The project was supported in part by the Union Carbide Agricultural Products Company, Inc.

GPO 589-949 / 375

U. S. DEPARTMENT OF AGRICULTURE
SCIENCE and EDUCATION ADMINISTRATION
WESTERN REGION
1333 BROADWAY, SUITE 400
OAKLAND, CALIFORNIA 94612

Return the mailing label(s) to above address if:

- ☐ Your name or address is wrong (indicate corrections, including ZIP).
- ☐ You receive duplicate copies (include labels from all copies received).
- ☐ You do NOT wish to continue receiving this technical series.